

Three new records of aspicilioid lichens from China

Xuejiao Hou¹, Shuxia Li¹, Qiang Ren^{1,2}

¹College of Life Science, Shandong Normal University, Ji'nan 250014, China

²Author for correspondence: rendaqiang@hotmail.com

Abstract

As a result of our studies on the lichen family Megasporaceae, three species new to China, *Aspicilia cupulifera* (H.Magn.) Oxner, *A. narssaquensis* (Lyngé) J.W.Thomson and *Circinaria arida* Owe-Larss., A.Nordin & Tibell are described and illustrated.

Introduction

The family Megasporaceae (Pertusariales, Lecanoromycetes, Ascomycota) originally contained only *Megaspora* (Clauzade & Cl.Roux) Hafellner & V.Wirth (Lumbsch et al. 1994). However, the circumscription of the family changed significantly with the application of molecular analyses. Consequently, Schmitt et al. (2006) transferred *Aspicilia* A.Massal. and *Lobothallia* (Clauzade & Cl.Roux) Hafellner from the Hymeneliaceae, while Nordin et al. (2010) returned *Circinaria* Link. and *Sagedia* Ach. to the Megasporaceae following an investigation of phylogenetic relationships.

The cosmopolitan genus *Aspicilia* includes 200–250 species (Sohrabi et al. 2013), 43 species having previously been reported from China (Wei 1991; Abbas and Wu 1998; Li et al. 2013). In addition, eight of the 28 species of *Circinaria* (Nordin et al. 2010; Sohrabi et al. 2012; Sohrabi et al. 2013) are known from China (Wei 1991; Abbas and Wu 1998; Ye et al. 2009). During our studies of aspicilioid lichens, three species new to China, *Aspicilia cupulifera*, *A. narssaquensis* and *Circinaria arida*, have been identified. All the specimens studied were collected from the western part of Qilian Mountains between Gansu and Qinghai Provinces of northwestern China, in mostly typical arid and semi-arid areas.

Materials and Methods

The specimens studied are preserved in SDNU (Shandong Normal University). Morphological and anatomical characters were examined using a dissecting microscope (Olympus SZ51) and a compact light microscope (Olympus CX21). The thalline cortex and medulla were tested with K (10% aqueous solution of potassium hydroxide), C (saturated solution of aqueous sodium hypochlorite), I (10% aqueous solution of aqueous potassium iodide) and P (saturated solution of *p*-phenylenediamine in 95% ethanol). Lichen substances were determined by standardized thin layer chromatography techniques (TLC) with solvent C (Orange et al. 2001). Habit photographs were taken with an Olympus SZX16 stereomicroscope, and anatomy was studied with an Olympus BX61 compound microscope with DP72.

The species

Aspicilia cupulifera (H.Magn.) Oxner, *Novosti Sistematiki Nizshikh Rastenii* 9: 287 (1972) Fig. 1

Thallus crustose, grey or grey-brown to brown; areoles contiguous, flat to slightly convex, angular or irregular, sometimes rounded, 0.2–1.5 mm in diam., rimose; prothallus brown-black to black; cortex 30–37.5 μm thick, with crystals; photobiont chlorococcoid, cells \pm round, 7.5–12.5 μm in diam.; apothecia aspicilioid, usually solitary, rarely numerous, occasionally 1 or 2 (or 3) per areole, 0.2–0.8 mm in diam.; disc black, epruinose; thalline margin prominent, black, distinct, usually forming a black rim; exciple K+ yellow; epihymenium olive-brown to brown, K+ brown, N+ green; hymenium hyaline, I+ blue, 125–150 μm tall; paraphyses submoniliform, richly branched and anastomosing; subhymenium and hypothecium colourless, I+ blue, together 50–75(–100) μm thick, algae not present below the hypothecium; asci clavate, *Aspicilia*-type, 8-spored; ascospores hyaline, simple, ellipsoid, (12.5–)15–20(–22.5) \times (7.5–)10–12.5(–15) μm ; pycnidia immersed, black; conidia filiform, straight or curved, 12.5–22.5 \times 0.8–1 μm .

Chemistry: Cortex K+ yellow, C–, KC+ yellow, P–; medulla K+ yellow, C–, KC+ yellow, P+ orange, I–; containing stictic and substictic acids (TLC).

Substrate and distribution: occurring on siliceous rock. *Aspicilia cupulifera* was previously known only from Finland (Magnusson 1939).

Specimen examined: China: Qinghai: Qilian County, Mt Niuxin, alt. 3270 m, on rock, Z. S. Sun 20071591, 11 Aug. 2007 (SDNU).

Comments: *Aspicilia cupulifera* is characterized by its grey or grey-brown thallus and apothecia with a prominent thalline margin. *Aspicilia subdepressa* (Nyl.) Arnold (Li et al. 2013) is morphologically similar to *A. cupulifera*, but the latter has a K+ yellow exciple, richly branched paraphyses, and a thinner hymenium.

Aspicilia narssaquensis (Lynge) J.W.Thomson, *Bryologist* 90(2): 163 (1987) Fig. 2

Thallus crustose, yellowish cream, pale grey or bluish to bluish grey, radiate-lobate at the margin; areoles 0.3–0.8 mm in diam., angular to irregular, or sometimes rounded, contiguous, flat to slight convex; prothallus indistinct; cortex 25–37.5 μm thick, with crystals; photobiont chlorococcoid, cells \pm round, 7.5–15 μm in diam.; apothecia aspicilioid, 0.4–1.0 mm in diam., usually solitary, or 2 or 3 per areole, rounded or angular; disc black, concave or plane, usually epruinose, rarely with a thin, white pruina; thalline margin indistinct, concolorous with the thallus; epihymenium olive-brown to brown, K+ brown, N+ green; hymenium hyaline, I+ blue, (100–)112.5–125(–150) μm tall; paraphyses moniliform, slightly branched and anastomosing; subhymenium

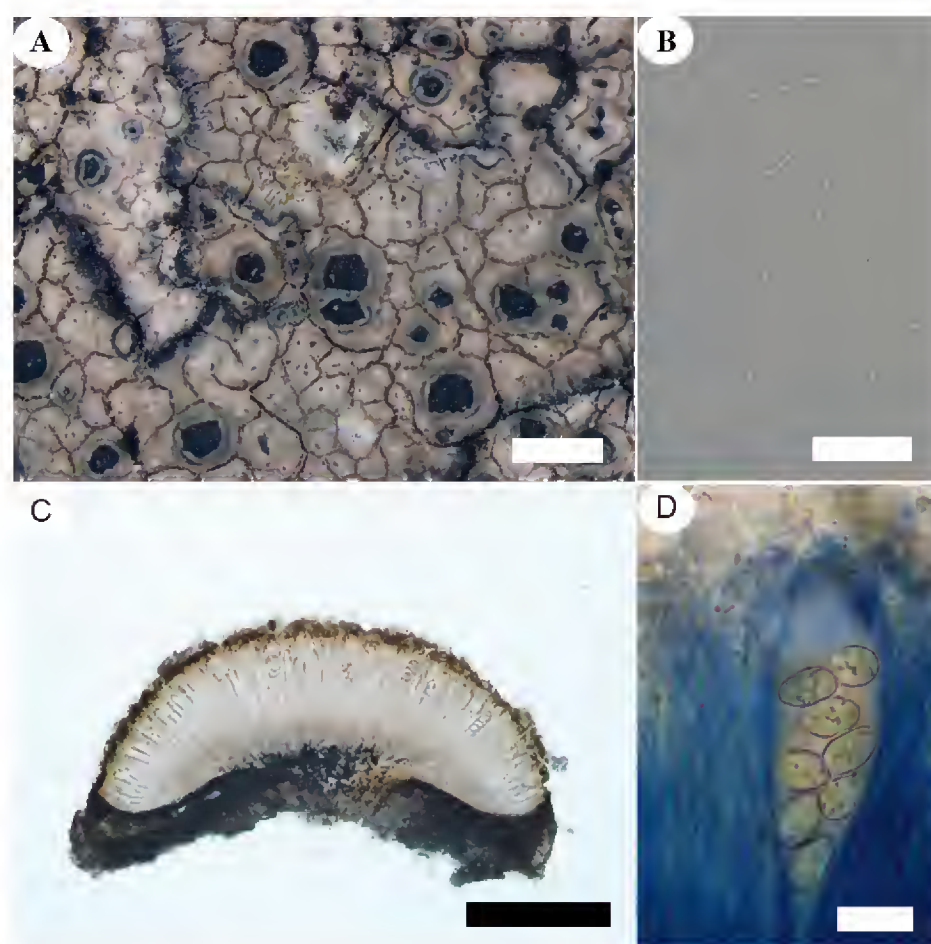


Fig. 1. *Aspicilia cupulifera* (Sun 20071591, SDNU). **A**, Thallus and apothecia; **B**, Conidia; **C**, Section of an apothecium; **D**, Ascus and ascospores after I treatment. Scale bars: A = 1 mm; B = 20 μm ; C = 300 μm ; D = 20 μm .

and hypothecium colourless, I+ blue, together 37.5–62.5(–100) μm thick, algae present below the hypothecium; asci clavate, *Aspicilia*-type, 8-spored; ascospores hyaline, simple, ellipsoid to subglobose, (10–)12.5–20(–22.5) \times 7.5–10(–12.5) μm ; pycnidia immersed, black; conidia filiform, 15–20 \times 0.8–1 μm .

Chemistry: Cortex K+ yellow, C–, KC+ yellow, P–; medulla K+ yellow, C–, KC+ yellow, P+ orange, I–; containing substictic acid (TLC).

Substrate and distribution: *Aspicilia narssaquensis* grows on calciferous rock. It has previously been reported from Norway (Øvstedal et al. 2009) and Arctic Canada and Greenland (Thomson 1997).

Specimens examined: China: Gansu: Sunan Yugur Autonomous County, Mt Jingtie, Diaodaban, alt. 4010 m, on rock, F. M. Zhang 2013320, Q. Ren 2013324, 22 Jun. 2013 (SDNU); Aksai Kazakh Autonomous County, Mt Dangjin, alt. 3700 m, on rock, S. X. Li 2013083, 2013084, 25 Jun. 2013 (SDNU).

Comments: *Aspicilia narssaquensis* is characterized by a yellowish cream thallus, K+ yellow medulla and apothecia lack of prominent thalline margin. *Aspicilia cupulifera* is similar to *A. narssaquensis* in spore size, but the former is distinguished by its grey to brown thallus, apothecia with prominent thalline margin, and the presence of stictic acid in the thallus.

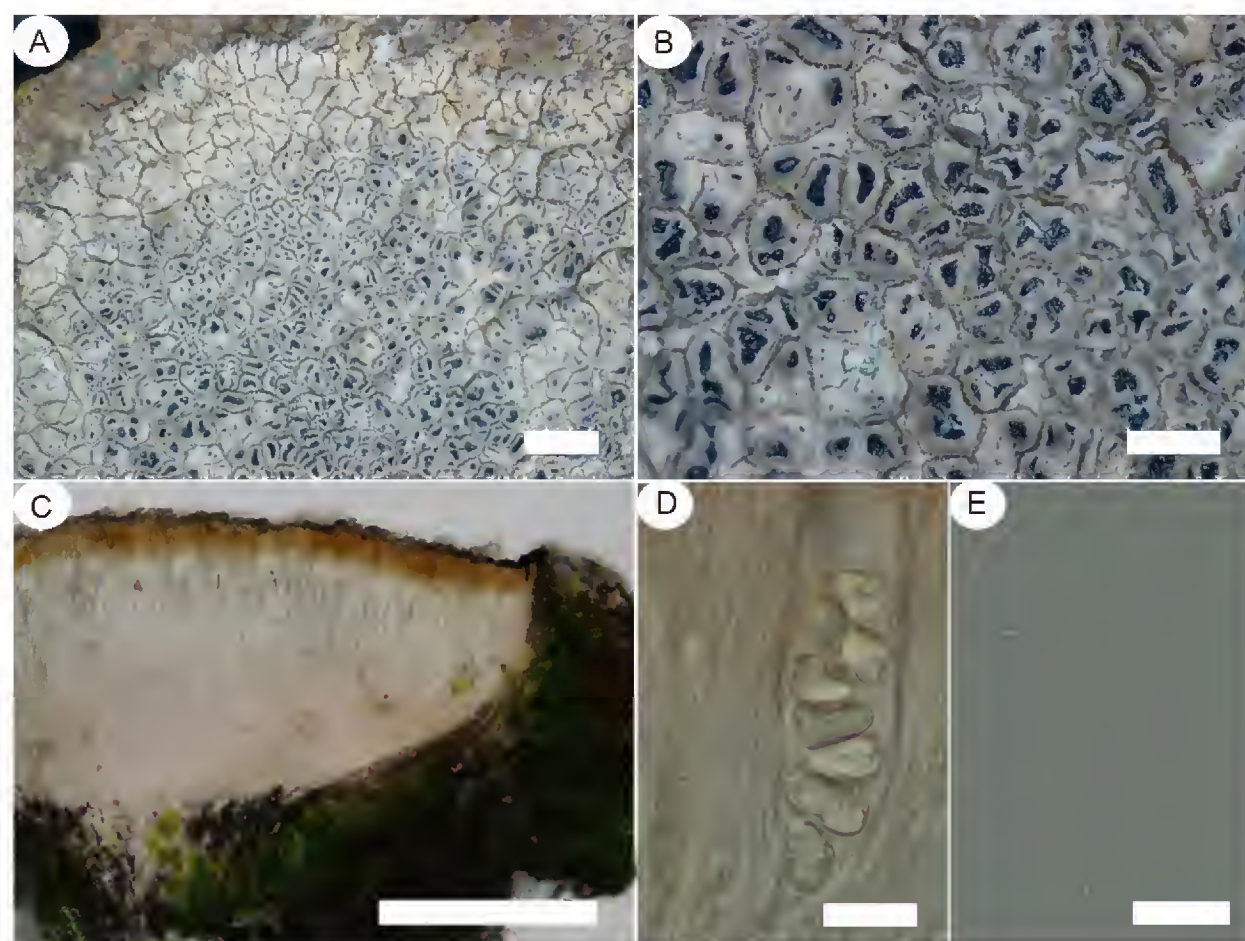


Fig. 2. *Aspicilia narssaquensis* (Zhang 2013320, SDNU). **A**, Thallus; **B**, Apothecia; **C**, Section of an apothecium; **D**, Ascus and ascospores; **E**, Conidia. Scale bars: A = 2 mm; B = 1 mm; C = 200 μm ; D, E = 20 μm .

Circinaria arida Owe-Larss., A.Nordin & Tibell, *Bibliotheca Lichenologica* 106: 240 (2011) Fig. 3

Thallus crustose, brown to olive-brown or grey-brown, areolate-verrucose, especially at the thallus margin; areoles contiguous and separated by narrow cracks, or sometimes \pm dispersed, angular to sometimes rounded or irregular, flat to finally \pm convex, 0.4–1 mm in diam.; prothallus rarely present, or indistinct, fimbriate or forming a narrow dark rim, brown or grey-brown to dark brown; cortex about 60–70 μm thick, with crystals, uppermost part dark brown, covered with an epinecral layer; photobiont chlorococcoid, cells \pm round, 12.5–20 μm in diam.; apothecia aspicilioid, 0.2–1 mm in diam., 1–3(or 4) per areole, angular or elongated to irregular, sometimes round; disc black, concave, usually with a thin, white pruina; thalline margin flat to slightly elevated, prominent in older apothecia, usually with a white to grey rim, concolorous with thallus or lighter; epihymenium brown or olive-brown, K+ brown, N+ green; hymenium hyaline, I+ blue, 100–162.5 μm high; paraphyses separating in KOH, moniliform, slightly branched and anastomosing; subhymenium and hypothecium colourless, I+ blue, together 25–50 μm thick; algae not present below the hypothecium; asci clavate, *Aspicilia*-type, 2–4(–6)-spored; ascospores hyaline, simple, subglobose to globose, (15–)17.5–25(–30) \times (10–)12.5–20(–25) μm ; pycnidia immersed, black; conidia filiform, straight, 5–12.5 \times 0.8–1 μm .

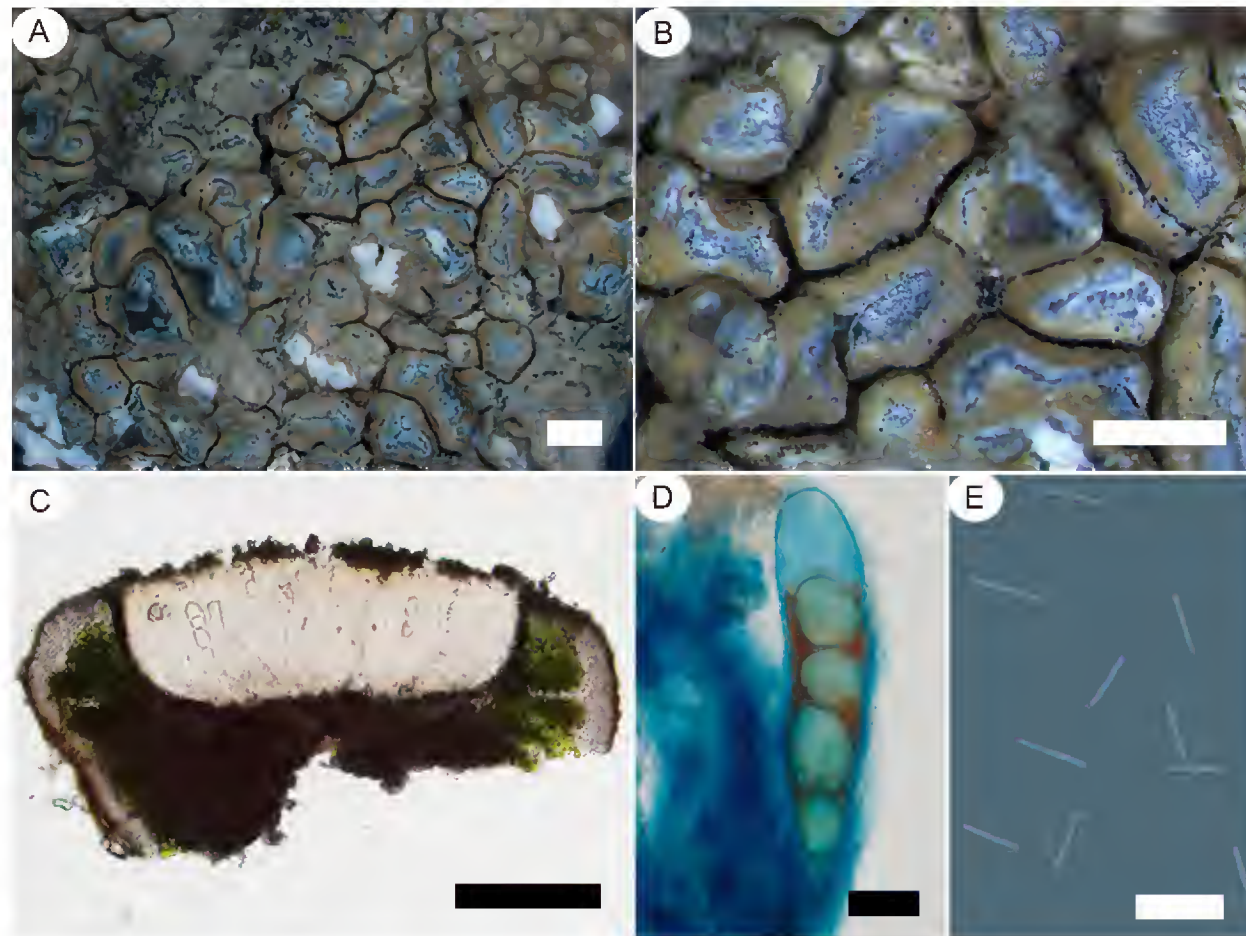


Fig. 3. *Circinaria arida* (Li 2013091, SDNU). **A**, Thallus; **B**, Apothecia; **C**, Section of an apothecium; **D**, Ascus and ascospores after I treatment; **E**, Conidia. Scale bars: A, B = 1 mm; C = 200 μ m; D = 20 μ m; E = 10 μ m.

Chemistry: Thallus K –, I –, C –, P –; usually with aspicilin, rarely lacking secondary metabolites.

Substrate and distribution: *Circinaria arida* grows on calciferous and siliceous rocks. It has been reported from South-western U.S.A. and adjacent parts of Mexico (Owe-Larsson et al. 2011).

Specimens examined: **China:** Gansu: Aksai Kazakh Autonomous County, Mt Dangjin, alt. 3700 m, on rock, S. X. Li 2013091, Q. Ren 2013092, 25 Jun. 2013 (SDNU); Yumen City, Qingxi Oilfield, alt. 2560 m, on rock, Q. Ren 2013288, S.X. Li 2013289, 2013290, 23 Jun. 2013 (SDNU). Qinghai: Wulan County, Chahannuo, alt. 3330 m, on rock, Q. Ren 2013032, 2013029, S.X. Li 2013028, 2013033, 26 Jun. 2013 (SDNU).

Comments: *Circinaria arida* is characterized by a brown to olive-brown or grey brown thallus, usually lacking a prothallus, with contiguous to dispersed areoles; numerous apothecia with pruinose discs; a thalline margin with a white rim; 2–6-spored asci; short conidia, and the presence of aspicilin. This species is similar to *Aspicilia desertorum* (Kremp.) Meresch. and *Circinaria contorta* (Hoffm.) A.Nordin, S.Savic & Tibell, but *A. desertorum* has a thick thallus with larger apothecia, and lacks aspicilin (Owe-Larsson et al. 2011), whereas *C. contorta* is distinguished by its white to grey or green-grey, rather thin thallus with \pm dispersed, flat areoles (Ye et al. 2009).

Acknowledgments

This study was funded by the National Natural Science Foundation of China (31370066), and the Excellent Young Scholars Research Fund of Shandong Normal University. The authors gratefully thank the two anonymous referees for their constructive comments.

References

- Abbas A, Wu JN (1998) Lichens of Xinjiang. (Xinjiang Science, Technology & Hygiene Publishing House: Urumqi) (in Chinese)
- Li SX, Kou XR, Ren Q (2013) New records of *Aspicilia* species from China. *Mycotaxon* 126: 91–96. <http://dx.doi.org/10.5248/126.91>
- Lumbsch HT, Feige GB, Schmitz KE (1994) Systematic studies in the Pertusariales I. Megasporaceae, a new family of lichenized ascomycetes. *Journal of the Hattori Botanical Laboratory* 75: 295–304.
- Magnusson AH (1939) Studies in species of *Lecanora*, mainly the *Aspicilia gibbosa* group. *Kongliga Svenska Vetenskapsakademiens Handlingar* 17(5): 1–182.
- Nordin A, Savić S, Tibell L (2010) Phylogeny and taxonomy of *Aspicilia* and Megasporaceae. *Mycologia* 102: 1339–1349. <http://dx.doi.org/10.3852/09-266>
- Orange A, James PW, White FJ (2001) Microchemical methods for the identification of Lichens. (British Lichen Society: London)
- Øvstedal DO, Tønsberg T, Elvebakk A (2009) The lichen flora of Svalbard. *Sommerfeltia* 33(1): 3–393.
- Owe-Larsson B, Nordin A, Tibell L, Sohrabi M (2011) *Circinaria arida* spec. nova and the ‘*Aspicilia desertorum*’ complex. *Bibliotheca Lichenologica* 106: 235–246.
- Schmitt I, Yamamoto Y, Lumbsch HT (2006) Phylogeny of Pertusariales (Ascomycotina): resurrection of Ochrolechiaceae and new circumscription of Megasporaceae. *Journal of the Hattori Botanical Laboratory* 100: 753–764.
- Sohrabi M, Stenroos S, Myllys L, Søchting U, Ahti T, Hyvönen J (2012) Phylogeny and taxonomy of the ‘manna lichens’. *Mycological Progress* 12: 231–269. <http://dx.doi.org/10.1007/s11557-012-0830-1>
- Sohrabi M, Leavitt SD, Rico VJ, Halici MG, Shrestha G, Stenroos S (2013) *Teuvoa*, a new lichen genus in Megasporaceae (Ascomycota: Pertusariales), including *Teuvoa junipericola* sp. nov. *Lichenologist* 45(3): 347–360. <http://dx.doi.org/10.1017/S0024282913000108>
- Thomson JW (1997) American Arctic Lichens 2. The Microlichens. (The University of Wisconsin Press: Madison)
- Ye J, Hou YZ, Zhang H, Han LF (2009) Two species of lichens new to China. *Mycosystema* 28(5): 762–764.
- Wei JC. (1991) An enumeration of lichens in China. (International Academic Publishers: Beijing)